

The image shows the front cover of a book. The cover is made of a brown material with a marbled pattern, featuring swirling, organic shapes in various shades of brown and tan. The texture appears slightly grainy. On the left side, there is a vertical white strip containing black text.

INDUSTRIAL LIGHTING CODE FOR FACTORIES. HD7279 U5 03



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# THE INDUSTRIAL COMMISSION OF OHIO

DEPARTMENT OF INSPECTION  
DIVISION OF  
WORKSHOPS, FACTORIES AND PUBLIC BUILDINGS

## INDUSTRIAL LIGHTING CODE FOR Factories, Mills and Other Work Places

Recommended by the General Advisory Committee and adopted by the Industrial Commission of Ohio as a guide in the inspection work of the Division of Workshops and Factories until such time as the Commission may deem it advisable to issue same as a general order.

Adopted May 6, 1920.



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# CODE OF LIGHTING FOR FACTORIES, MILLS AND OTHER WORK PLACES

## Rule 1. General Requirements.

Work spaces in buildings or grounds and spaces which an employee is required to traverse in the performance of duty shall be provided with light during the time of use in accordance with the following rules:

## RULE 2. Intensity.\*

The minimum intensities of illumination which shall be maintained and the preferable intensities are as follows:

<i>Grade.</i>	FOOT-CANDLE AT FLOOR LEVEL.	
	<i>Minimum.</i>	<i>Preferable.</i>
A. Prescribed and designated yard thoroughfares, roadways and passageways.....	1/50	1/20 to 1/4
B. Intermediate and auxiliary spaces in interiors.....	1/4	1/2 to 2

	FOOT-CANDLES ON THE WORK.	
	<i>Minimum.</i>	<i>Preferable.</i>
C. First Degree Operation (work not requiring discrimination of detail as handling material of a course nature).	1/2	1 to 3
D. Second Degree Operation (rough manufacturing requiring discrimination of detail).....	1	2 to 6
E. Third Degree Operation (medium manufacturing requiring closer discrimination of detail).....	2	3 to 9
F. Fourth Degree Operation (fine manufacturing).....	3	4 to 12
G. Fifth Degree Operation (finest manufacturing).....	5	8 to ..
H. Processes, otherwise safeguarded, in which light is detrimental .....	0	.....

In order to take into account degree of precision in measurement, a variation of 15% below the above intensity values will be allowed.

The Industrial Commission of Ohio shall specify the grade of illumination to be provided for any given operation.

Accidental temporary diminution or total loss of illumination, resulting from failure of energy supply conductors or lamps, or from the presence of unusual quantities of smoke, steam or fog, shall not be construed as failure of the employer to comply with the provisions of this rule.

## Rule 3. Glare.

Objectional glare resulting from either natural or artificial light shall be eliminated wherever possible. Exception may be made in the case of glare which is necessary in performing a specific operation.

**Rule 4. Distribution.**

Lighting facilities shall be so provided, with reference to direction and distribution of light, as to give illumination on the work without objectionable shadows and deep contrasts of intensity.

The classification of various industrial operations included in the Industrial Classifications of Section 6 of the Appendix is not a part of Rule 2 but gives the standards recognized by the Industrial Commission of Ohio.

Measurements of the illumination is to be made in the principal plane in which the work is done; that is, on the horizontal, vertical or on intermediate plane as the case may be.

"On the work" signifies at whatever points vision is required in the performance of the given operation. While permanent and general lighting is preferable in most cases, the intensity requirements of this rule may be met by the use of localized or portable light sources.

There are three principal factors which determine the proper classification of a given manufacturing operation.

1. The reflection factor of the surface worked upon; dark material require higher intensities than those of light color.
2. The fineness of detail to be observed.
3. The closeness of application required.

**Rule 5.**

Until July 1, 1921, when the Industrial Commission shall give consideration to the advisability of issuing the code as a General Order, no provision of this code shall be considered to be a "General Order" or a "Legal Requirement", except when, and only when the provision or provisions thereof shall be embraced in a special order issued by the Industrial Commission or its agencies direct to operators of plants specifically designated and giving specific instructions for carrying the same into effect in such plant.



## APPENDIX TO THE CODE OF LIGHTING FOR FACTORIES, MILLS AND OTHER WORK PLACES

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This appendix is not a part of the code, but contains explanations and suggestions to those responsible for carrying out and for enforcing the rules of the code.

1. **Flux of Light.** Every light source emits a certain flow or flux of light which may be looked upon as a volume of light rays proceeding out from the source of straight lines in all directions. When these fall upon anybody they are either transmitted, reflected or absorbed.

2. **Unit of Flux, The Lumen.** The amount of this flux, other things being equal, is a measure of the value of the source of light. Its unit is the "lumen".

3. **Candle-power.** The unit of light intensity is the candle-power. A lamp is said to give a light intensity of five candle-power in the direction of some given small object, when it gives five times as much light to this object as would be given by an international candle, if it were substituted for the lamp under consideration.

4. **Illumination.** The above units refer to the light source itself and are independent of its surroundings. When a light-source is used for purposes of illumination, the light falling upon the surface to be worked upon or otherwise observed, becomes the object of interest. This illumination depends not only upon the amount of distribution of the light from the source, but also depends, in varying degree, upon the reflection from the ceiling, walls and other lighted surfaces.

5. **Unit of Illumination, The Foot-Candle.** This lighting of the surface is called quantitatively "Illumination" and its common unit is the foot-candle. This is the illumination on a surface one foot from a light, which gives one candle-power in the direction of the surface. A surface lighted to an intensity of one foot candle receives one lumen of light flux per square foot. Minimum and preferable values of illumination are given in Rule 2 of the Code.

6. **Light Intensity.** The minimum values of intensities given in Rule 2 are based on the minimum standards for safety and health only. The higher figures given under the "preferable" column are generally advisable, not only from the standpoint of safety and health, but also production, and even higher intensities are often used.

The following is a classified list giving the light intensity grades recognized by The Industrial Commission of Ohio for factories, mills and other work places:

<i>Industrial Classification.</i>		<i>Intensity Grade.</i>	<i>Foot-Candle Minimum.</i>	<i>Intensity Preferable.</i>
<i>Aisles</i> .....		B	$\frac{1}{4}$	$\frac{1}{2}$ to 2
<i>Assembling—</i>				
Rough assembling .....	D	1	2 to 6	
Medium assembling .....	E	2	3 to 9	
Fine assembling .....	F	3	4 to 12	
Extra fine assembling.....	G	5	8 to ..	
<i>Automobile Manufacturing—</i>				
See machine shops, paint shops, wood-work- ing shops, etc.				
<i>Bakeries—</i>				
Mixing and baking.....	E	2	3 to 9	
<i>Boiler, Engine Rooms and Power Houses—</i>				
Boilers .....	C	$\frac{1}{2}$	1 to 3	
Coal and ash handling.....	C	$\frac{1}{2}$	1 to 3	
Engines, generators, blowers, compressors...	E	2	3 to 9	
Auxiliary equipment .....	D	1	2 to 6	
Oil switches and transformers.....	D	1	2 to 6	
Switchboards .....	D	1	2 to 6	
Storage battery rooms.....	C	$\frac{1}{2}$	1 to 3	
<i>Brewing, Distilling and Bottling—</i>				
Boiling .....	D	1	2 to 6	
Bottling .....	E	2	3 to 9	
Clearing or resting and fermenting.....	C	$\frac{1}{2}$	1 to 3	
Cool ship .....	C	$\frac{1}{2}$	1 to 3	
Keg Washing .....	D	1	2 to 6	
Keg filling .....	D	1	2 to 6	
<i>Candy Making—</i>				
Cooking over furnaces.....	E	2	3 to 9	
Cooling slabs .....	E	2	3 to 9	
Cream beater machines.....	E	2	3 to 9	
Dipping (hand) .....	E	2	3 to 9	
Molding .....	E	2	3 to 9	
Revolving pan .....	E	2	3 to 9	
Spinning bench .....	E	2	3 to 9	
Weights and measures.....	E	2	3 to 9	
Wrapping and packing.....	E	2	3 to 9	
<i>Canning and Preserving—</i>				
Cooking .....	E	2	3 to 9	
Assorting, cleaning, cutting and peeling....	E	2	3 to 9	
Hand filling .....	E	2	3 to 9	
Machine filling .....	E	2	3 to 9	

Note that intermediate and auxiliary spaces in interiors require Grade B.



<i>Industrial Classification.</i>	<i>Intensity Grade.</i>	<i>Foot-Candle Minimum.</i>	<i>Intensity Preferable.</i>
<i>Chemical Works—</i>			
Mechanical furnaces .....	D	1	2 to 6
Hand furnaces .....	C	$\frac{1}{2}$	1 to 3
Tanks for cooking, extractors, percolators, nitrators .....	E	2	3 to 9
Boiling tanks .....	C	$\frac{1}{2}$	1 to 3
Generators and stills.....	D	1	2 to 6
Mechanical dryers .....	D	1	2 to 6
Stationary dryers .....	C	$\frac{1}{2}$	1 to 3
Evaporators .....	D	1	2 to 6
Filtration .....	D	1	2 to 6
Mechanical crystallizing .....	D	1	2 to 6
Stationary or gravity crystallizing.....	C	$\frac{1}{2}$	1 to 3
Bleaching .....	D	1	2 to 6
Electrolytic cells .....	E	2	3 to 9

*Clay Products and Cements—*

Enameling .....	E	2	3 to 9
Grinding .....	C	$\frac{1}{2}$	1 to 3
Filter presses .....	C	$\frac{1}{2}$	1 to 3
Molding and pressing.....	D	1	2 to 6
Cleaning and trimming.....	D	1	2 to 6
Coloring and glazing.....	F	3	4 to 12
Kiln rooms .....	C	$\frac{1}{2}$	1 to 3
Kiln yards .....	B	$\frac{1}{4}$	$\frac{1}{2}$ to 2

*Cloth Products—*

	<i>Lt. Dark.</i>		<i>Lt. Dark.</i>		<i>Light.</i>	<i>Dark.</i>
Cutting .....	F	G	3	5	4 to 12	8 to ..
Sewing (Machine) .....	F	G	3	5	4 to 12	8 to ..
Sewing (Hand) .....	F	G	3	5	4 to 12	8 to ..
Pressing .....	F	G	3	5	4 to 12	8 to ..
Inspecting .....	F	G	3	5	4 to 12	8 to ..
Cloth treating (oil cloth, etc.).	E	F	2	3	3 to 9	4 to 12

<i>Industrial Classification.</i>	<i>Intensity Grade.</i>	<i>Foot-Candle Minimum.</i>	<i>Intensity Preferable.</i>
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*Construction—*

Indoor .....	C	$\frac{1}{2}$	1 to 3
Outdoor .....	B	$\frac{1}{4}$	$\frac{1}{2}$ to 2

*Dairy Products—*

Separators, evaporators, churns, molds and presses .....	E	2	3 to 9
Pasteurizing .....	E	2	3 to 9
Bottle, canning and labeling.....	E	2	3 to 9
Ice Cream freezers.....	E	2	3 to 9

<i>Draughting</i> .....	G	5	8 to ..
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Note that intermediate and auxiliary spaces in interiors require Grade B.



<i>Industrial Classification.</i>	<i>Intensity</i>	<i>Foot-Candle</i>	<i>Intensity</i>			
	<i>Grade.</i>	<i>Minimum.</i>	<i>Preferable.</i>			
<i>Electric Manufacturing —</i>						
Coil and armature winding.....	F	3	4 to 12			
Mica working .....	F	3	4 to 12			
Insulation molding .....	F	3	4 to 12			
Other insulating processes.....	F	3	4 to 12			
Storage battery-molding or girds.....	E	2	3 to 9			
Lamp manufacturing .....	G	5	8 to ..			
Wire insulating .....	F	3	4 to 12			
<i>Elevators, Freight and Passenger.....</i>	C	½	1 to 3			
<i>Engine Rooms — (See boiler).</i>						
<i>Forge Shops and Welding —</i>						
Rough forging .....	D	1	2 to 6			
Fine forging .....	E	2	3 to 9			
Drop forging .....	E	2	3 to 9			
Spot and butt welding.....	E	2	3 to 9			
Arc Welding .....	E	2	3 to 9			
<i>Foundries —</i>						
Rough molding .....	D	1	2 to 6			
Fine molding .....	E	2	3 to 9			
Core making, rough.....	D	1	2 to 6			
Core making, fine.....	E	2	3 to 9			
Charging floor .....	C	½	1 to 3			
Tumbling .....	C	½	1 to 3			
Cleaning .....	C	½	1 to 3			
Pouring and shaking out.....	C	½	1 to 3			
<i>Glass Works —</i>						
Mix rooms .....	D	1	2 to 6			
Furnace room .....	D	1	2 to 6			
Casting and Lehr.....	D	1	2 to 6			
Grinding .....	E	2	3 to 9			
Fine grinding and polishing.....	F	3	4 to 12			
Glass blowing machine.....	E	2	3 to 9			
Cutting glass to size.....	E	2	3 to 9			
Glass cutting (cut glass).....	G	5	8 to ..			
Beveling .....	F	3	4 to 12			
Silvering .....	E	2	3 to 9			
Inspecting, medium .....	F	3	4 to 12			
Inspecting, fine .....	G	5	8 to ..			
Etching and decorating.....	F	3	4 to 12			
<i>Glove Manufacturing —</i>						
	<i>Lt. Dark.</i>	<i>Lt. Dark.</i>	<i>Light.</i>	<i>Dark.</i>		
Sorting .....	F	G	3	5	4 to 12	8 to ..
Cutting .....	E	F	2	3	3 to 9	4 to 12
Stitching .....	F	G	3	5	4 to 12	8 to ..
Trimming and inspecting.....	F	G	3	5	4 to 12	8 to ..
Pressing .....	E	F	2	3	3 to 9	4 to 12
Knitting .....	E	F	2	3	3 to 9	4 to 12

Note that intermediate and auxiliary spaces in interiors require Grade B.



<i>Industrial Classification.</i>	<i>Intensity Grade.</i>	<i>Foot-Candle Minimum.</i>	<i>Intensity Preferable.</i>
<i>Halls and Passageways in Interiors</i> .....	B	¼	½ to 2

<i>Hat Manufacturing—</i>	<i>Lt. Dark.</i>	<i>Lt. Dark.</i>	<i>Light.</i>	<i>Dark.</i>
Forming, sizing, pouncing, flanging, finishing and ironing .....	E	F	2 3	3 to 9 4 to 12
Dyeing and stiffening.....	D	E	1 2	2 to 6 3 to 9
Braiding .....	D	E	1 2	2 to 6 3 to 9
Cleaning and refining.....	D	E	1 2	2 to 6 3 to 9
Sewing .....	F	G	3 5	4 to 12 8 to ..

<i>Industrial Classification.</i>	<i>Intensity Grade.</i>	<i>Foot-Candle Minimum.</i>	<i>Intensity Preferable.</i>
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<i>Ice Manufacture—</i>			
Ice making .....	D	1	2 to 6

<i>Inspecting—</i>			
Rough inspecting .....	D	1	2 to 6
Medium inspecting .....	E	2	3 to 9
Fine inspecting .....	F	3	4 to 12
Extra fine inspecting.....	G	5	8 to ..

<i>Jewelry and Watch Manufacturing—</i>			
Bench work and extra fine machine work....	G	5	8 to ..
Stamping .....	G	5	8 to ..
Engraving .....	G	5	8 to ..
Jewel working .....	G	5	8 to ..
Machine work .....	G	5	8 to ..

<i>Laundries and Dry Cleaning—</i>			
Sorting and marking.....	E	2	3 to 9
Washing .....	D	1	2 to 6
Mangles and machine ironing.....	E	2	3 to 9
Pressing and hand ironing.....	E	2	3 to 9
Dry and steam cleaning.....	E	2	3 to 9

<i>Leather Manufacturing—</i>			
Cleaning, tanning and stretching, etc.....	D	1	2 to 6
Cutting, fleshing and stuffing.....	E	2	3 to 9
Finishing and scarfing.....	F	3	4 to 12
Vats .....	C	½	1 to 3

<i>Leather Working—</i>	<i>Lt. Dark.</i>	<i>Lt. Dark.</i>	<i>Light.</i>	<i>Dark.</i>
Grading and matching.....	F	G	3 5	4 to 12 8 to ..
Cutting and scarfing.....	F	G	3 5	4 to 12 8 to ..
Sewing .....	F	G	3 5	4 to 12 8 to ..
Pressing and winding.....	E	F	2 3	3 to 9 4 to 12

Note that intermediate and auxiliary spaces in interiors require Grade B.



<i>Industrial Classification.</i>	<i>Intensity Grade.</i>	<i>Foot-Candle Minimum.</i>	<i>Intensity Preferable.</i>	
<i>Docker Rooms</i> .....	C	½	1 to 3	
<i>Machine Shops—</i>				
Rough bench and machine work.....	D	1	2 to 6	
Medium bench and machine work.....	E	2	3 to 9	
Fine bench and machine work.....	F	3	4 to 12	
Extra fine bench and machine work.....	G	5	8 to ..	
Automatic machines (ordinary).....	E	2	3 to 9	
Automatic machines (fine).....	F	3	4 to 12	
Grinding—				
Rough work .....	E	2	3 to 9	
Medium work .....	F	3	4 to 12	
Fine work .....	G	5	8 to ..	
Buffing and polishing—				
Medium work .....	E	2	3 to 9	
Fine work .....	F	3	4 to 12	
<i>Meat Packing—</i>				
Slaughtering .....	D	1	2 to 6	
Cleaning and cutting.....	E	2	3 to 9	
Cooking .....	E	2	3 to 9	
Grinding and packing.....	E	2	3 to 9	
Canning .....	E	2	3 to 9	
<i>Milling and Grain Food Products—</i>				
Cleaning .....	D	1	2 to 6	
Grinding or rolling.....	D	1	2 to 6	
Baking or roasting.....	E	2	3 to 9	
<i>Offices</i> .....	F	3	4 to 12	
<i>Packing—</i>				
Rough .....	D	1	2 to 6	
Medium .....	E	2	3 to 9	
Fine .....	F	3	4 to 12	
<i>Paint Manufacturing</i> .....	D	1	2 to 6	
<i>Paint Shops—</i>				
Dipping or spraying.....	D	1	2 to 6	
Rubbing .....	E	2	3 to 9	
Firing .....	D	1	2 to 6	
Hand painting and finishing, ordinary.....	E	2	3 to 9	
Hand painting and finishing, fine.....	F	3	4 to 12	
Hand painting and finishing, extra fine— automobile bodies, piano cases, etc.....	G	5	8 to ..	
<i>Paper Box Manufacturing—</i>	<i>Lt. Dark.</i>	<i>Lt. Dark.</i>	<i>Light.</i>	<i>Dark.</i>
Cutting .....	D	E	1 2	2 to 6 3 to 9
Machine folding .....	D	E	1 2	2 to 6 3 to 9
Hand folding .....	D	E	1 2	2 to 6 3 to 9
Pasting and assembling.....	D	E	1 2	2 to 6 3 to 9

Note that intermediate and auxiliary spaces in interiors require Grade B.



<i>Industrial Classification.</i>	<i>Intensity Grade.</i>	<i>Foot-Candle Minimum.</i>	<i>Intensity Preferable.</i>
<i>Paper Manufacturing —</i>			
Beaters .....	D	1	2 to 6
Calendaring .....	E	2	3 to 9
Machine .....	D	1	2 to 6
Grinding .....	D	1	2 to 6
Finishing, cutting and trimming.....	F	3	4 to 12
<i>Passageways — See Halls.</i>			
<i>Plating —</i>			
Plating .....	D	1	2 to 6
Polishing and burnishing.....	E	2	3 to 9
<i>Power House — See Boiler.</i>			
<i>Printing Industries —</i>			
Linotype and monotype.....	G	5	8 to ..
Typesetting .....	G	5	8 to ..
Composing stone .....	G	5	8 to ..
Matrizing and casting.....	E	2	3 to 9
Miscellaneous machines .....	E	2	3 to 9
Proof reading .....	F	3	4 to 12
Presses, job and small automatic.....	E	2	3 to 9
Presses, rotary, flat, bed, etc.....	E	2	3 to 9
Lithographing .....	F	3	4 to 12
Electrotyping .....	F	3	4 to 12
Engraving .....	G	5	8 to ..
<i>Receiving and Shipping.....</i>	D	1	2 to 6
<i>Roadways and Yard Thoroughfares.....</i>	A	1/50	1/20 to 1/4
<i>Rubber Manufacturing and Products —</i>			
Compounding .....	D	1	2 to 6
Mills .....	D	1	2 to 6
Calenders .....	E	2	3 to 9
Fabric preparation and stock cutting.....	D	1	2 to 6
Tubing machine .....	D	1	2 to 6
Bead building .....	E	2	3 to 9
Pneumatic tire building and finishing.....	E	2	3 to 9
Solid tire operations.....	D	1	2 to 6
Inner tube operations.....	E	2	3 to 9
Mechanical goods building.....	D	1	2 to 6
Mechanical goods trimming.....	E	2	3 to 9
All vulcanizing .....	D	1	2 to 6
<i>Shafting, Pulleys and Other Mechanical Trans-</i>			
<i>mission .....</i>	C	1/2	1 to 3

Note that intermediate and auxiliary spaces in interiors require Grade B.



<i>Industrial Classification.</i>	<i>Intensity Foot-Candle Intensity</i>		
	<i>Grade.</i>	<i>Minimum.</i>	<i>Preferable.</i>
<i>Sheet Metal Working —</i>			
Bench work, ordinary.....	E	2	3 to 9
Bench work, fine.....	F	3	4 to 12
Punches, presses, shears, stamps and welders	F	3	4 to 12
Spinning .....	F	3	4 to 12
Miscellaneous machines .....	E	2	3 to 9

			<i>Lt. Dark.</i>	<i>Lt. Dark.</i>	<i>Light.</i>	<i>Dark.</i>
<i>Shoe Manufacturing, Leather and Canvas—</i>						
Inspecting and sorting raw material .....	F	G	3	5	4 to 12	8 to ..
Cutting .....	F	G	3	5	4 to 12	8 to ..
Stitching, machine .....	G	G	5	5	8 to ..	8 to ..
Stitching, hand .....	F	G	3	5	4 to 12	8 to ..
Lasting and welding.....	F	F	3	3	4 to 12	4 to 12
Hand turning .....	E	E	2	2	3 to 9	3 to 9
Miscellaneous bench and machine work .....	E	F	2	3	3 to 9	4 to 12

<i>Industrial Classification.</i>	<i>Intensity Foot-Candle Intensity</i>		
	<i>Grade.</i>	<i>Minimum.</i>	<i>Preferable.</i>
<i>Soap Manufacturing —</i>			
Kettle houses .....	D	1	2 to 6
Framing .....	C	$\frac{1}{2}$	1 to 3
Cutting .....	D	1	2 to 6
Stamping, wrapping and packing.....	E	2	3 to 9
Soap chip .....	D	1	2 to 6
Soap powder .....	D	1	2 to 6
Filling and packing soap powder.....	E	2	3 to 9
<i>Stairways .....</i>	B	$\frac{1}{4}$	$\frac{1}{2}$ to 2
<i>Steel and Iron Mills, Bar Sheet and Wire Products —</i>			
Automatic machines .....	E	2	3 to 9
Charging floor .....	C	$\frac{1}{2}$	1 to 3
Casting floor .....	C	$\frac{1}{2}$	1 to 3
Soaking pits and reheating furnaces.....	B	$\frac{1}{4}$	$\frac{1}{2}$ to 2
Muck and heavy rolling.....	D	1	2 to 6
Rod, light and cold rolling.....	E	2	3 to 9
Wire drawing .....	E	2	3 to 9
Shearing, rough by gage.....	D	1	2 to 6
Shearing, fine by line.....	E	2	3 to 9
Pickling and cleaning.....	D	1	2 to 6
<i>Stone Crushing and Screening —</i>			
Primary breaker room.....	C	$\frac{1}{2}$	1 to 3
Auxiliary breakers .....	C	$\frac{1}{2}$	1 to 3
Belt conveyor tubes.....	B	$\frac{1}{4}$	$\frac{1}{2}$ to 2
Screen rooms .....	D	1	2 to 6
Chute rooms .....	B	$\frac{1}{4}$	$\frac{1}{2}$ to 2
Inside of bins.....	B	$\frac{1}{4}$	$\frac{1}{2}$ to 2
Under bins .....	C	$\frac{1}{2}$	1 to 3

Note that intermediate and auxiliary spaces in interiors require Grade B.

<i>Industrial Classification.</i>	<i>Intensity Foot-Candle Intensity</i>				
	<i>Grade.</i>	<i>Minimum.</i>	<i>Preferable.</i>		
<i>Stone Cutting —</i>					
Machine cutting .....	D	1	2 to 6		
Sand cutting .....	D	1	2 to 6		
Carving .....	E	2	3 to 9		
Polishing .....	E	2	3 to 9		
<i>Store and Stock Rooms —</i>					
Rough stock .....	C	½	1 to 3		
Medium stock .....	D	1	2 to 6		
Fine stock .....	E	2	3 to 9		
<i>Structural Steel Fabricating</i> .....	E	2	3 to 9		
<i>Telegraph —</i>					
Operating .....	F	3	4 to 12		
Auxiliary telegraph and dynamo equipment..	E	2	3 to 9		
<i>Telephones —</i>					
Automatic .....	F	3	4 to 12		
Manual exchanges .....	D	1	2 to 6		
<i>Testing —</i>					
Rough .....	D	1	2 to 6		
Medium .....	E	2	3 to 9		
Fine .....	F	3	4 to 12		
Extra fine .....	G	5	8 to ..		
<i>Textile Mills —</i>					
<i>Cotton —</i>					
Opening and lapping.....	D	1	2 to 6		
Carding .....	D	1	2 to 6		
Drawing frame .....	D	1	2 to 6		
Roving, spooling, spinning, etc.....	E	2	3 to 9		
Warping .....	D	1	2 to 6		
Slashing .....	D	1	2 to 6		
Dyeing .....	E	2	3 to 9		
Drawing in .....	E	2	3 to 9		
Weaving .....	E	2	3 to 9		
<i>Silk —</i>					
Winding .....	E	2	3 to 9		
Throwing .....	E	2	3 to 9		
Dyeing .....	E	2	3 to 9		
	<i>Lt. Dark.</i>	<i>Lt. Dark.</i>	<i>Light.</i>	<i>Dark.</i>	
Quilling and warping....	E	F	2 3	3 to 9	4 to 12
Weaving .....	F	G	3 5	4 to 12	8 to ..
Finishing .....	F	G	3 5	4 to 12	8 to ..

Note that intermediate and auxiliary spaces in interiors require Grade B.



<i>Industrial Classification.</i>	<i>Intensity Grade.</i>	<i>Foot-Candle Minimum.</i>	<i>Intensity Preferable.</i>
<i>Woolen—</i>			
Picking .....	E	2	3 to 9
Washing and combing.....	E	2	3 to 9
Carding .....	D	1	2 to 6
Twisting .....	E	2	3 to 9
Dyeing .....	E	2	3 to 9

	<i>Lt.</i>	<i>Dark.</i>	<i>Lt.</i>	<i>Dark.</i>	<i>Light.</i>	<i>Dark.</i>
Drawing in .....	E	F	2	3	3 to 9	4 to 12
Warping .....	E	F	2	3	3 to 9	4 to 12
Weaving .....	F	G	3	5	4 to 12	8 to ..
Perching .....	G	G	5	5	8 to ..	8 to ..

<i>Industrial Classification.</i>	<i>Intensity Grade.</i>	<i>Foot-Candle Minimum.</i>	<i>Intensity Preferable.</i>
Knitting machines, ordinary and nappers	E	2	3 to 9
Knitting machines, flat and others.....	F	3	4 to 12
Cordage mills .....	E	2	3 to 9

*Tobacco Products—*

All operations .....	E	2	3 to 9
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<i>Toilet and Wash Rooms.....</i>	C	½	1 to 3
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*Welding— (See Forge Shop) —*

*Wood Working—*

Rough sawing (saw mills).....	D	1	2 to 6
Sizing, planing, rough sanding, etc.....	E	2	3 to 9
Machine wood working, medium.....	E	2	3 to 9
Machine wood working, fine.....	F	3	4 to 12
Bench work, rough.....	D	1	2 to 6
Bench work, medium.....	E	2	3 to 9
Bench work, fine.....	F	3	4 to 12
Fine sanding and finishing.....	F	3	4 to 12
Gluing and veneering.....	E	2	3 to 9
Cooperage .....	E	2	3 to 9

7. **Quality of Illumination.** Under this head are chiefly considered glare, diffusion and colors. It is not sufficient merely to insure that the required quantity of light is provided, the quality of the illumination is also very important.

8. **Glare.** While adequate illumination must be provided, it is equally important that the light be supplied in such a way as will not cause discomfort or injury to the eyes. Thus, among the most frequent and serious cases of bad lighting are those due to glare in its various forms.

Note that intermediate and auxiliary spaces in interiors require Grade B.

Glare may result from one or more of the following conditions:

- (a) The source of light may lie too far within the field of vision, that is, the angle between the line of sight and the line to the light source is too small.
- (b) The light source may be too bright, that is, too much light flux from a small area.
- (c) There may be too great contrasts between the bright light source and a dark back ground or adjacent surfaces.
- (d) The total quantity of light entering the eye may be excessive.

The harmful effects of glare are much affected by:

- (a) Distance from a light source in the field of vision.
- (b) Time of exposure to the light source.

The most common and objectionable cases of glare are those which are due to unshaded and inadequately shaded lamps located within the field of vision.

To reduce such glare, the following practice should be observed:

- (a) No lamp within view from any position at which work is performed and at a height above the eye level less than one-fourth its lateral distance from the worker should expose to his eye any square inch of surface giving more than 75 candle power. Such shading is not required if the height of the units above the floor is 20 feet or greater. The necessity of reduction of the intrinsic brilliancy of any exposed part of the light source increases as the height is reduced and the total candlepower from the lamp is increased; thus in the case of lamps of 200 candlepower or less, suspended 15 feet or more above the floor, such protection becomes less important.
- (b) No lamp suspended less than  $6\frac{1}{2}$  feet above the floor should expose to the eye at any position at which work is performed, any square inch of luminous surface giving more than 5 candlepower; lower value are to be preferred.

The above provisions will not eliminate all glare, but will correct the most serious cases. In many situations more complete shading is to be recommended.

Glare resulting from contrast will, of course, be much more serious in the case of dark walls and ceilings than where these are painted a light color.

Serious glare may result from specular reflection from polished and other materials upon which work is being performed. In the case of large working surfaces, or curved surfaces, glare can usually be avoided only by increasing the area of the light course and thus reducing its



brightness. In the case of work having small, flat, polished surface, it is frequently possible to avoid glare by changing the relative position of the work or worker and the light source provided the light source be of small area.

For some special purposes, notably in inspection of polished surfaces, or in working with fine details, the reflected image of a bright source is the best method of illumination.

Portable lamps are frequently sources of objectionable glare and should be protected either by shades or by the use of frosted or other types of diffusing bulbs.

The use of flood lights should be made with care, but by suitably locating at sufficient height, satisfactory results can be obtained.

Glare results in decreased ability to see, it may cause temporary discomfort, and if the condition is long continued may result in permanent injury to the eyesight. This decreased ability to see results in a lower quality and decreased quantity of output; consequently aside from the discomfort and danger to the eyes, glare is economically bad.

Since the bad effects of glare are dependent upon time of exposure to the same, glare due to temporary or emergency lighting is to be considered from the point of view of danger of accidents rather than of discomfort.

9. **Distribution of Light.** The distribution determines the degree of uniformity of illumination. It also determines the direction of the light and thus defines the edges, shape and contour of any object illuminated.

10. **Diffusion.** Light may come solely from a single source of small dimensions or it may come from a large surface or from a number of smaller units. In the last two cases the light is more or less diffused. This is much better for most purposes because the shadows are then less sharp and less black.

11. **Color and Other Characteristics.** The applicability of light to various special uses depends upon its color.

Steadiness and reliability are other essential qualities of good lighting.

12. **Summary of Principles.** The following general principles of illumination, whether daylight or artificial, may thus be stated:

- (a) The light should be adequate at the darkest point in the illuminated space.
- (b) Glare should be avoided.
- (c) The illumination should be fairly uniform throughout the working space.
- (d) The light should be properly directed and suitably diffused.

- (e) The color of the light should be suitable to the purpose for which it is to be used.
- (f) The light should be steady and reliable.

13. **Daylight.** Daylight is usually the preferred source of light. The satisfaction that will be obtained from daylight, however, depends much more than is ordinarily recognized upon careful and intelligent planning for its use and control. To make daylight illumination fulfill the requirements of good practice, the following points should be observed:

14. **Planning and Location of Building.** This should be done with proper reference to the points of the compass.

15. **Distances From Windows.** Rooms depending upon side-window lighting should be designed to keep down the maximum distance of any worker from the window to not more than twice the height of the tops of the windows above the floor.

16. **Roof Lights.** Properly designed saw-tooth roof-lights or sky-lights are frequently advisable.

17. **Design of Light Openings.** The size and location of the windows, saw-tooth lights, or sky-lights should be designed so as to throw as much light as possible into the darker portions of the room. To this end the wall windows should be carried near to the ceiling, especially in low or deep rooms. Generally they should occupy as much of the wall space above the working plane as possible.

18. **Special Glass.** The use of translucent glass, wire glass and ribbed or prism glass should be considered only for the upper portions of windows and for sky-lights. In the use of ribbed glass, the ribs should be horizontal in windows and lengthwise in sky-lights, and used with discretion. Prism glass should be of a design fitted to the particular use for which it is to be applied.

19. **Shades and Awnings.** Translucent and opaque shades or awnings should be used where needed. Opaque shades should generally be arranged to pull upward. This cuts off the excess light from the workers near the windows, while allowing light to come through the upper portion for the more distant ones. From the point of view of good lighting, direct sunlight is to be avoided, on account of the glare and contrasts produced, as well as to great intensity of the illumination. Likewise the reflection of the sun, especially from polished surfaces, should be avoided.

20. **Wall Finish.** To decrease glaring contrasts, to improve the diffusion of the light and to increase the efficiency by reflection, the ceiling and upper walls should be finished in a light color. For greater comfort to the eyes, the lower walls should be of a medium tint, such as light buff or light green. Mat finishes are preferred to glossy surfaces.



21. **Location of Equipment.** All work benches, tools and equipment should be properly located with reference to the direction of the natural light. Benches should preferably run at right angles to the window surfaces.

22. **Maintenance.** The proper and regular cleaning of all windows is of great importance in the maintenance of good daylight illumination, this is especially true with ribbed and prism glass.

23. **The Value of Good Illumination.** The following advantages of good lighting may be noted:

- (a) Reduction of accidents and injuries.
- (b) Better workmanship and hence less spoiled material.
- (c) Increased production with the same labor cost and factory space.
- (d) Less eyestrain, conservation of eyesight and better health.
- (e) Better working conditions and, by example, better living conditions.
- (f) More contented workmen, longer service and less cost for training employees.
- (g) Better order and greater neatness in the work room.
- (h) Easier and better supervision.

24. **Accident Prevention.** It will be noted that the last five of these items have a bearing on accident prevention. The important relation between accidents and poor lighting are strikingly indicated by the fact that with the coming of short and dark days in winter the number of accidents throughout the industries increases. Furthermore, in many cases where good lighting has been substituted for poor lighting, a marked decrease in the number of accidents has resulted. The financial, as well as the human aspect, of this situation is apparent.

25. **Economy.** One important consideration has to do with the relative costs of illumination and labor. The total cost of good lighting is always a very small fraction of the cost of production. It varies considerably in the different industries but the average is less than 1% of the labor cost alone. In most industries if a saving of 2 to 5 minutes per day of the workers' time is made by installing a system of good lighting, the added cost will be a profitable expenditure. Usually the saving would be many times these figures. Statistics indicate that the entire annual cost of adequate lighting for all of the industries of the country, would be less than the cost of the industrial accidents now occurring and which are due to the lack of proper illumination. Industrial concerns which have made the most exhaustive study of production, accident prevention and welfare work are the strongest advocates of good illumination.





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INDUSTRIAL LIGHTING CODE FOR FACTORIES,



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